Application Serial No.	:	10/714,031
Filed	:	14 November 2003
Applicant	:	W. Hubis
Title	:	METHODS AND STRUCTURE FOR A CACHING TO ROUTER IN ISCSI STORAGE SYSTEMS
Art Unit	:	2144
Examiner	:	G. C. Bengzon
Docket Number	:	03-1651
Date	:	2 May 2008

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDED APPEAL BRIEF

Sir:

Appellant herewith files an Amended Brief in respond to the Notification of Non-Compliant Appeal Brief mailed by the USPTO on 12 May 2008. A Brief in support of the Appeal in the above identified matter and the $510 fee under 37 CFR 41.20(b)(2) for the Appeal Brief were filed on May 2, 2008. Appellant presumes no further fees are required for filing of this brief.

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i. REAL PARTY IN INTEREST

The real party in interest is the current assignee LSI CORPORATION - a new corporate name for LSI LOGIC CORPORATION (the employer of the inventor at the time of the invention and the preceding assignee of the patent rights in the above-identified matter).

ii. RELATED APPEALS AND INTERFERENCES

No other appeals, interferences, or related applications are known to the Appellant, the Appellant's legal representative, or the Assignee, which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

iii. STATUS OF CLAIMS

Claims 1-7, 10, 11, 13, 15, 17-18, and 21-22 are pending and stand rejected in the application for consideration on appeal. Claims 1-6, 11, 15, and 18 were rejected under 35 U.S.C. §103(a) as unpatentable over Mullendore (US Patent Publication 2003/0185154) in view of that which he deems well known in the art. Claims 7, 10, 13, 17, and 21-22 were rejected under 35 U.S.C. §103(a) as unpatentable over Mullendore in view of Liu, Wei et al. (US Patent Publication 2004/0117441). Claims 8, 9, 12, 14, 16, 19, and 20 were previously cancelled. The rejection of all remaining claims under 35 U.S.C. §103(a) forms the basis of this appeal.

iv. STATUS OF AMENDMENTS

No amendments have been filed since the final office action mailed 4 January 2008.

v. SUMMARY OF THE CLAIMED SUBJECT MATTER

Although TCP/IP protocols have been used for decades for exchange of data between systems, as applied to storage networks, only file oriented protocols but have been used therewith until recently. By comparison, iSCSI utilizes TCP/IP protocols to transfer lower layer block I/O requests through the network communication medium. By utilizing long established TCP/IP protocols, iSCSI may be applied to storage networks using presently existing, time-proven, less costly network communication media. iSCSI therefore presents users with a compromise that permits use of existing network communication infrastructure while benefiting from reduced storage related processing overhead. Use of such networking protocols communication media also allows for application of similarly well known, time-proven networking devices (i.e., networked appliances) such as, hubs, switches, routers, etc. In the storage arts it is generally known to utilize caching techniques to improve performance in accessing storage devices. Caching techniques utilize a high speed buffer memory to store recently accessed information stored on the storage devices such that subsequent requests for the same data may be satisfied by the information in the cache buffer memory. Accessing the requested data from the cache memory rather than on the storage device is generally much faster. Caching therefore improves overall storage system performance by increasing the speed of access to previously stored data. In networked storage applications, including iSCSI configurations, it is an ongoing problem to improve performance in accessing storage devices. Applications, including in particular multimedia applications, continue to demand higher and higher performance levels from storage subsystems.

The invention provides methods and structure for integrating network routing features and storage caching features within a single network appliance. In particular, the invention comprises a caching router applicable to, for example, iSCSI network storage applications. The caching router provides routing capabilities well known in TCP/IP communications and couples such routing capabilities with block oriented storage caching features to improve block oriented I/O request processing in storage network applications including iSCSI storage applications.

Still more specifically, the invention of independent claim 1 recites network appliance comprising a TCP/IP router (see, e.g., routers 100, 102 of figure 1; specification p. 6 line 21, p.7 lines 23-31, p. 8 lines 5-6, and p. 9 line 10) for routing block level requests from a first device (see, e.g., workstations 122, 142 of figure 1; specification p. 6 lines 23 -24, 30-31, p. 7 lines 8, 14-15, and 34) to a second device (see, e.g., storage device 104..110 of figure 1; specification p. 7 lines 9-12, 16-17, 27-28, 32-33). The appliance further comprises a cache memory (see, e.g., memory 210 of figure 2; specification p. 9 lines 8, 15-16, 18) for caching storage data blocks accessed by the block level requests. The cache memory is used by the router to store data blocks (see, e.g., element 401 of figure 4; specification p. 12 lines 31-34) from the first device and to return data blocks (see, e.g., element 404 of figure 4; specification p. 12 lines 18-19) to the first device responsive to a block level storage request directed to the second device without forwarding the request to the second device (logic path in flowchart of FIG. 4 comprising steps 400, 402, 404, and 406; specification p. 12 lines 13-24).

Independent method claim 11 recites receiving a block level storage request from a first device directed to a second device and processing the request (see, e.g., elements 400…418 of figure 4; specification p. 12 line 12 - p. 14 lines 8). The processing comprises attempting to locate data requested by the first device in the cache memory (see, e.g., element 402 of figure 4; specification p. 12 lines 16-18 and 24-28). If the data is located the data is returned to the first device (see, e.g., elements 402, 404 of figure 4 and specification p. 12 lines 16-18). The request is only forwarded through the router to the second device in response to a failure to locate the requested data in the cache memory of the router (see, e.g., elements 402, 408 of figure 4; specification p. 12 lines 24-28).

Independent claim 15 recites an iSCSI router including an inbound network interface (see, e.g., network interface 206 of figure 2; specification p. 9 line 20) and an outbound network interface (see, e.g., network interface 208 of figure 2; specification p.9 line 21). The router of claim 11 also comprises a cache memory (see, e.g., memory 210 of figure 2; specification p. 9 lines 8, 15-16, 18) and a control element (see, e.g., control element 200 of figure 2; specification p. 9 lines 34-35 and p. 10 line 28) coupled to the

interfaces and the cache memory. The cache memory is used by the control element to store data blocks (see, e.g., element 401 of figure 4; specification p. 12 lines 31-34) from the first device and to return data blocks (see, e.g., element 404 of figure 4; specification p. 12 lines 18-19) to the first device responsive to a block level storage request directed to the second device without forwarding the request to the second device (logic path in flowchart of FIG. 4 comprising steps 400, 402, 404, and 406; specification p. 12 lines 13-24).

Independent claim 18 similarly recites an improved router including a SCSI command and response processor (see, e.g., microcontroller 200 including elements 302..311 - noting that microcontroller 200 is mis-labeled as 300 in figure 3; control element 200 of figure 2; specification p. 9 lines 34-35 and p. 10 line 28). The router of claim 18 also comprises a cache memory (see, e.g., memory 210 of figure 2; specification p. 9 lines 8, 15-16, 18) and a control element (see, e.g., control element 200 of figure 2; specification p. 9 lines 34-35 and p. 10 line 28) coupled to the interfaces and the cache memory. The cache memory is used by the SCSI command and response processor to store data blocks (see, e.g., element 401 of figure 4; specification p. 12 lines 31-34) from the first device and to return data blocks (see, e.g., element 404 of figure 4; specification p. 12 lines 18-19) to the first device responsive to a block level storage request directed to the second device without forwarding the request to the second device (logic path in flowchart of FIG. 4 comprising steps 400, 402, 404, and 406; specification p. 12 lines 13-24).

The remaining dependent claims recite further limitations relative to their respective base claims.

vi. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. Whether claims 1-7, 10, 11, 13, 15, 17-18, and 21-22 are unpatentable under 35 U.S.C. §103(a) as unpatentable over Mullendore in view of that which is well known in the art or in view of Liu, Wei.

vii. ARGUMENT

§103 Rejection of Claims 1-7, 10, 11, 13, 15, 17-18, and 21-22

The Examiner rejected claims 1-7, 10, 11, 13, 15, 17-18, and 21-22 under 35 U.S.C. §103(a) as unpatentable over Mullendore in view of that which he deems well known in the art or in view of Liu Wei. The Examiner's rejection finds all the features of, for example, rejected claim 1 in Mullendore but for use of the cache memory in the router to return requested data without forwarding the request from the first device to the second device. The Examiner asserts such a caching feature is well known and one would be motivated to modify Mullendore with such a caching capability to improve performance.

In particular, as regards independent claim 1, the Examiner points to paragraph 0072 in describing figure 7 of Mullendore as teaching all but one recited element. The Examiner asserts that paragraph 0072 and figure 7 of Mullendore teaches the recited router and cache memory including use of the cache memory to store data exchanged between a first and second device coupled to the router. The Examiner acknowledges that Mullendore fails to teach that the cache memory is used as recited to return data blocks requested by the first device from the second device without forwarding the request to the second device. The Examiner then asserts that such caching techniques are well known at the time of the invention and thus one would be motivated to modify Mullendore to use such well known caching techniques to improve performance.

Applicant responds that use of a cache in other contexts to speed read request processing is generally known in the art and is admitted in the Background section of the subject application. For example, processors and storage devices/systems use such caching techniques. However, such caching is not known in the art of network appliances and in particular iSCSI routers. Rather, a router's intended purpose is to pass an exchange from a source device to a destination device (generally based on addressing information provided). Network/iSCSI routers do not at present monitor or process the semantic content of such exchanges to determine if an exchange represents a "write" or "read" request from a first device to request data from a second device and further to process such a request when recognized. Still further, the claimed invention completes processing

of a read request and returns data to the first device (requesting device) directly from the cache memory of the network appliance without forwarding the read request to the second device. Only the enhanced router processing of this invention can process the read request from the cache memory without ever forwarding the exchange to the destination device.

As regards independent claim 1, the Examiner points to paragraph 0072 in describing figure 7 of Mullendore as teaching all recited elements. While Applicant admits that Mullendore uses the word "cache" he provides no explanation of its function other than as a buffer to hold data in far-end switch 240 until an addressed far-end target device 245 is ready to accept more data. In other words, Mullendore teaches nothing more than a simple buffer for "speed matching" in the transfers between an initiator 235 and a target 245. Nothing in Mullendore teaches the complexity of a router that processes the block level storage requests exchanged between a first and second iSCSI device coupled through the router. By so processing the block level storage requests, the router of claim 1 may store data blocks in its local cache memory as they are exchanged between the first and second devices. In addition, when the first device issues a read block level storage request, the router may complete the request by returning data blocks directly from its local cache memory without ever forwarding the storage request to the second device (e.g., without forwarding a read request from a host system to the target device.).

Originally filed dependent claim 14 (originally dependent from 11 - now integrated therein) and 20 (originally dependent from 18 - now integrated therein) included similar recitations and were rejected in the first office action (mailed 24 July 2007). There the Examiner rejected claims 14 and 20 under §103 as unpatentable over Mullendore in view of "well-known" prior art making essentially the same argument as he does now in the final office action mailed 4 January 2008. Applicant strongly disagreed in the response filed 24 October 2007. The Examiner maintains the same position in this final rejection stating in essence that it would be obvious to combine the standard features of an iSCSI router as taught by Mullendore with the admitted prior art (namely - admitted art that caching functions in other contexts are well known). There is

no art provided by the Examiner or any suggestion in the art to apply cache memory management techniques and structures within a network appliance router (a TCP/IP storage router). As noted, Mullendore suggests nothing more than well-known speed-matching buffering. Though Mullendore arguably misuses the word "cache" in reference to his buffer he makes clear that the buffer is used merely to hold data (in far-end switch 240) until the receiving device (target 245) is ready to receive more data - the very essence of a speed-matching buffer. Mullendore suggests nothing more of use of the buffer for cache purposes such as recited in original claims 14 and 20 (now integrated into each independent claim 1, 11, 15, and 18). These caching features in a network appliance router (e.g., a TCP/IP router) are the very essence of the present invention.

Thus it is only through improper hindsight applying the teachings of the subject application that the Examiner asserts this "well-known" knowledge.

The Examiner rejected all other claims based on the same fundamental teachings of Mullendore and the same arguments apply to those rejected claims.

In view of the above discussion Applicant maintains that claim 1 is allowable over Mullendore alone or as modified in view of well known art or Liu, Wei and over all art of record, considered individually or in any combination. The Examiner rejected other independent claims 11, 15, and 18 applying similar reasons and thus Applicant urges that claims 11, 15, and 18 are allowable for at least the same reasons as discussed above with respect to claim 1. Further, dependent claims 2-7, 10, 13, 17, and 21-22 depend variously from base claims 1, 11, 15, and 18 and recite further limitations. The remaining dependent claims are thus maintained to be allowable for at least the same reasons as discussed above with regard to claims 1, 11, 15, and 18. Applicant therefore requests reversal of the Examiner's rejection of all outstanding claims.

viii. CLAIMS APPENDIX

1. A storage network appliance comprising:

a TCP/IP router for routing block level storage requests through a TCP/IP network communication medium from a first device coupled to the router to a second device coupled to the router; and

a cache memory coupled to the router for caching storage data blocks accessed by the block level storage requests,

wherein the cache memory is used by the router to store data blocks exchanged between the first and second devices through the router, and

wherein the cache memory is used to return data blocks from the cache memory to the first device in response to a received block level storage request directed from the first device to read data blocks from the second device without forwarding the storage request to the second device.

2. The appliance of claim 1 further comprising:

a command and response processor coupled to the router for interpreting block level storage requests routed through the router and coupled to the cache memory for caching data identified in the interpreted block level storage requests.

3. The appliance of claim 2 wherein the block level storage requests are iSCSI protocol commands and responses.

4. The appliance of claim 3 wherein the command and response processor is a SCSI command and response processor.

5. The appliance of claim 2 wherein the command and response processor is adapted to snoop the block level storage requests routed by the router.

6. The appliance of claim 2 wherein the router is adapted to store and forward received requests.

7. The appliance of claim 6 wherein the command and response processor is adapted to process received requests while the requests are temporarily stored for forwarding.

8. (Cancelled)

9. (Cancelled)

10. The appliance of claim 2 wherein the command and response processor is adapted to coalesce multiple block level storage write requests into a coalesced block level storage write request and wherein the router is adapted to forward the coalesced block level write request to a destination device in place of the multiple block level storage write requests.

11. A method operable in a network router comprising the steps of:

receiving a block level storage request from a network communication medium directed through the router from a first device to a second device; and

processing the received block level storage request in association with a cache memory local to the router, wherein the processing further comprises:

responsive to receipt of a block level storage request from the first device to return data from the second device, locating data requested by the received block level storage request in the cache memory;

returning the located data to a requesting first device in response to locating the requested data; and

conditionally forwarding the received request to the second device only in response to failure to locate the requested data in the cache memory.

12. (Cancelled)

13. The method of claim 11 further comprising:

coalescing multiple received block level storage requests into a coalesced block level storage request; and

forwarding the coalesced block level storage request to a destination device.

14. (Cancelled)

15. An iSCSI router comprising:

an inbound network interface for receiving iSCSI storage requests and for returning responses to received iSCSI storage requests;

an outbound network interface for forwarding received iSCSI requests to a destination device and for receiving responses from the destination device;

a cache memory; and

a control element coupled to the inbound network interface, coupled to the outbound network interface, and coupled to the cache memory and adapted to process iSCSI requests received on the inbound network interface in association with the cache memory and adapted to selectively forward processed iSCSI requests to a destination device via the outbound network interface,

wherein the cache memory is used by the control element to store data blocks exchanged between a first device coupled to the inbound network interface and a second device coupled to the outbound network interface, and

wherein the cache memory is used to return data blocks from the cache memory to the first device in response to a received block level storage request directed from the first device to read data blocks from the second device without forwarding the storage request to the second device.

16. (Cancelled)

17. The router of claim 15 wherein the control element further comprises:

a request coalescing element for coalescing multiple received requests into a coalesced request,

wherein the control element is further adapted to forward the coalesced request to the destination device.

18. An improved network router compatible with TCP/IP protocols and adapted for coupling to one or more host systems and one or more iSCSI compatible storage devices, the improvement comprising:

a SCSI command and response processor within the router to process iSCSI commands and responses forwarded through the router; and

a cache memory within the router coupled to the SCSI command processor for caching data related to iSCSI commands and responses processed by the SCSI command and response processor,

wherein the SCSI command and response processor is adapted to process iSCSI read requests by first attempting to locate requested data in the cache memory and wherein received iSCSI read requests are forwarded to a storage device only if the requested data is not located by the processor in the cache memory.

19. (Cancelled)

20. (Cancelled)

21. (Currently Amended) The improved router of claim 18 wherein the SCSI command and response processor is adapted to process iSCSI write requests by storing the associated write data in the cache memory.

22. The improved router of claim 21 wherein the SCSI command and response processor is further adapted to coalesce data stored in the cache memory into a larger coalesced write request and is further adapted to route the coalesced write request to the storage device.

xi. EVIDENCE APPENDIX

None.

x. RELATED PROCEEDINGS APPENDIX

None.

SUMMARY

Appellant argues that the Examiner's rejection of claims 1-7, 10, 11, 13, 15, 17-18, and 21-22 under 35 U.S.C. §103(a) as unpatentable over Mullendore in view of that which he deems well known in the art or in view of Liu, Wei are inadequate as a matter of law and should be reversed. It is believed that this Amended Appeal Brief has been timely filed within one month of mailing of the Notice of Panel Decision from Pre-Appeal Brief Review mailed on 2 April 2008. However, if an extension of time is deemed to be required by the Patent Office, the Patent Office is hereby requested to accept this request as a petition for an appropriate extension of time to respond with any requisite fees therefore being charged to deposit account 12-2252.

Respectfully submitted,

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